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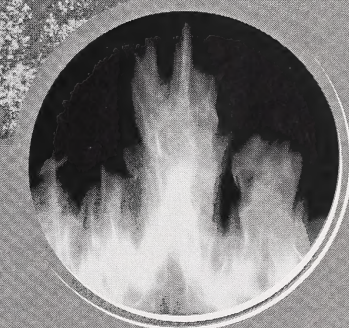
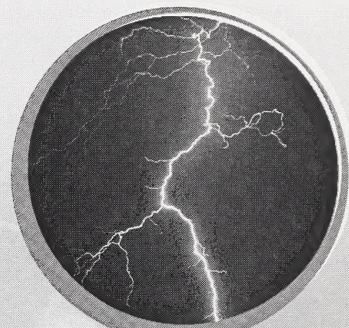
SCIENCE 9

Module

4

Electrical Principles and Technologies

***Home Instructor's Guide
and Assignment Booklet 4A***



**Learning
Technologies
Branch**

Alberta
LEARNING

Science 9
Module 4: Electrical Principles and Technologies
Home Instructor's Guide and Assignment Booklet 4A
Learning Technologies Branch
ISBN 0-7741-2593-4

Cover Art: middle right: Corbis
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The Learning Technologies Branch acknowledges with appreciation the Alberta Distance Learning Centre and Pembina Hills Regional Division No. 7 for their review of this Home Instructor's Guide and Assignment Booklet.

This document is intended for	
Students	✓
Teachers	✓
Administrators	
Home Instructors	✓
General Public	
Other	



You may find the following Internet sites useful:

- Alberta Learning, <http://www.learning.gov.ab.ca>
- Learning Technologies Branch, <http://www.learning.gov.ab.ca/lrb>
- Learning Resources Centre, <http://www.lrc.learning.gov.ab.ca>

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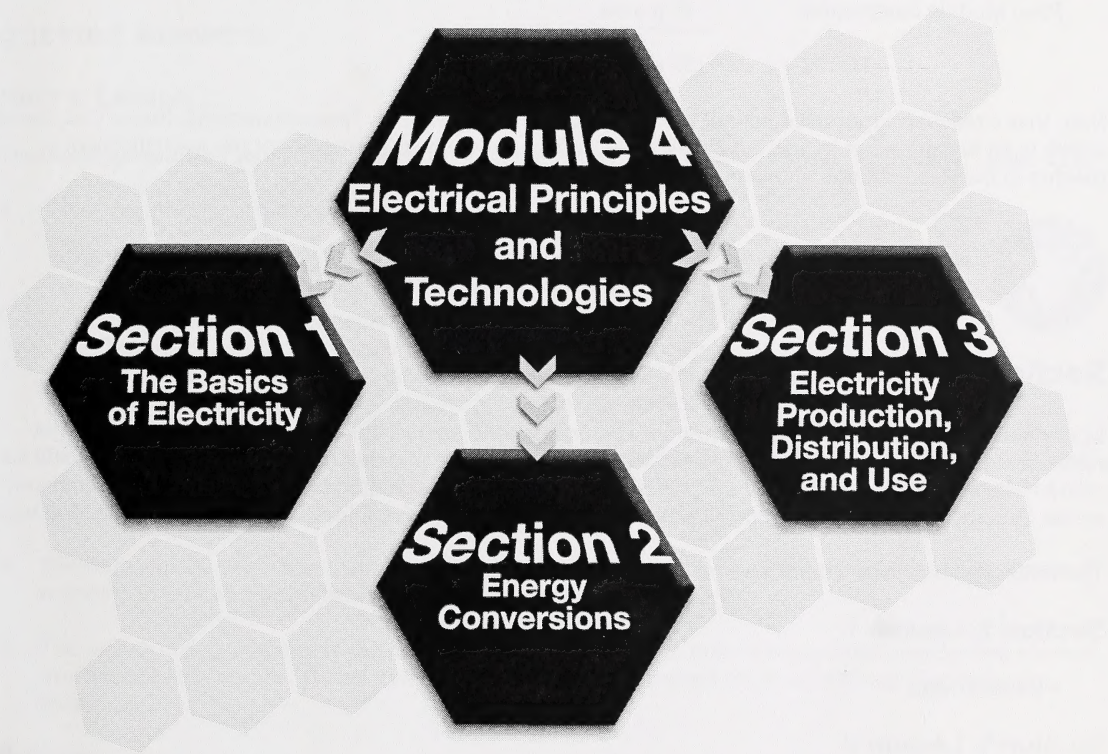
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Module 4: Electrical Principles and Technologies

The major emphasis of this module is Science and Technology.

Electricity provides the means to energize many devices in the student's world. In this module the student will investigate various aspects of electricity—the control of electricity, its use, production, and distribution. Using a problem-solving approach, the student will construct and modify circuits. The student will evaluate electrical devices and systems. This evaluation will be based on efficiency, effectiveness, and environmental impact.



Assessment

The student's successful completion of all assignments in the Assignment Booklets will depend on practice obtained while doing the various activities and readings. Choices of activities have been provided so that students have some control over their own learning.

The following distribution of marks is suggested in determining the student's grade for this module.

Assignment Booklet 4A	
Section 1 Assignment	37 marks
Section 2 Assignment	36 marks
Assignment Booklet 4B	
Section 3 Assignment	33 marks
Final Module Assignment	49 marks
<hr/>	
TOTAL	155 marks

Note that a teacher-supervised school laboratory is recommended for "Investigation 4E: Super Cell Sleuth," which is an investigation in Section 2: Lesson 2. Talk to the course teacher about the availability of a teacher-supervised school laboratory.



Students should have safety goggles and latex gloves for all investigations involving the manipulation of materials. Have students pay attention to all safety icons.

Section 1: The Basics of Electricity

In this section the student distinguishes between static and current electricity. The student finds that resistance to electron flow generates heat. Resistors, which are made to have resistance, can be used to control the amount of current and voltage in an electric circuit. The student investigates electric current in series circuits and parallel circuits. The student uses Ohm's law to compare current, resistance, and voltage.

The following materials will be needed to complete this section.

Section 1: Lesson 1

- paper towels

Section 1: Lesson 2

- tape
- two fresh D-cells
- two battery (cell) holders
- five, 15 cm wires with stripped ends
- a 3.7 V bulb
- a multimeter
- two bulb sockets
- two, 2.5 V bulbs
- a knife switch
- 12 alligator clips

Section 1: Lesson 3

- three, 3.7 V bulbs and three bulb holders
- two fresh D-cells
- tape
- two battery (cell) holders
- eight, 15 cm wires with stripped ends
- a multimeter
- a knife switch

Section 1: Lesson 4

No extra materials are needed for this lesson.

Suggested Answers

Section 1: Lesson 2

1. Textbook questions 1 to 4 from “What Did You Find Out?” and question from “Extension,” page 272:

1. These requirements must be met:

- The circuit must be complete.
- The switch has to be closed.
- The cells must be connected from positive to negative terminals.
- The wires touching the bulb must make contact at two separate points.
- The bulb filament must be intact.
- The cells must have sufficient energy to make the device work.

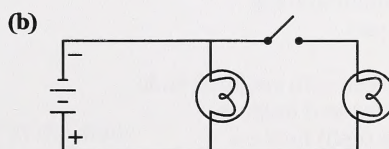
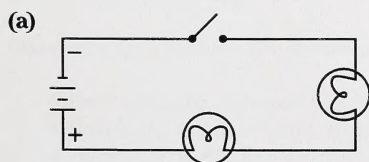
2. If any one of the conditions in question 1 is not met, the bulb will not glow. The electrons must have a complete pathway and enough electrical energy to move from the negative terminal, through the load(s) and controls, and back to the positive terminal.

3. The bulb glowed when electrons moved through it in either direction. It glowed when the cells were reversed in 2(b) and when the bulb contacts were switched in 2(c).

4. The switch closes and opens the circuit. It provides either an uninterrupted pathway for the current, or a break in the circuit. The switch allows the bulb to be turned on or off without disconnecting wires.

Extension

Note the following diagrams for (a) and (b).



Section 1: Lesson 4

Textbook questions 1 to 9 from “Wrap-up: Topics 1 to 3,” page 292:

1. *laws of charges*
2. *unbalanced charges*
3. *semiconductor*
4. *loads*
5. *voltage*
6. *resistance*
7. *series circuit*
8. *Ohm's law*
9. To produce an electric charge on a solid object, electrons are either added or removed from the object by rubbing it with a different type of material. One material must have loose electrons—it will become positively charged. The other material must attract electrons—a negative charge will build up on its surface.

Section 2: Energy Conversions

In this section the student will focus on transformations between electricity and other forms of energy—thermal, mechanical, light, and chemical energy. The student will investigate cells and batteries as technological devices that provide electrical energy through energy transformation.

The following materials will be needed to complete this section.

Section 2: Lesson 1

No extra materials are needed for this lesson.

Section 2: Lesson 2

- a multimeter
- various coins (pennies, nickels, dimes, and so on)
- a saturated salt solution
- paper towels
- heavy-duty aluminum foil
- a steel wool pad
- scissors
- two, 15 cm wires with stripped ends
- two, 3.7 V bulbs and holders
- three battery (cell) holders
- three fresh D-cells
- tape

Section 2: Lesson 3

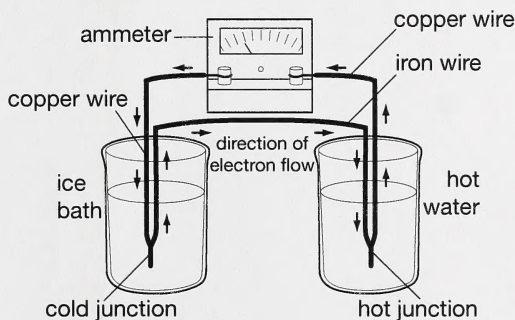
No extra materials are needed for this lesson.

Suggested Answers

Section 2: Lesson 3

Textbook questions 1, 3, 5, 6, and 9 of “Wrap-up: Topics 4 to 5,” page 308:

- heat
 - thermocouple
 - piezoelectric effect
 - thermopile
 - photovoltaic cell
 - electrodes
 - electrolyte
- The student diagram should be similar to the following.



- Thermo-electric generators have no moving parts—they are solid state—and therefore need little maintenance. They are also reliable.
- Galvani hypothesized that the electricity was produced by frog tissue only.

Volta demonstrated that a “pile” of two dissimilar metals in an ionic (salt or acidic) solution would also produce electricity. The demonstration contradicted Galvani’s hypothesis instead of supporting his hypothesis.

- An advantage is that air pollution from cars would be reduced. Also, fuel cells are an efficient energy conversion technology.

Disadvantages include the following:

- Fuel cells are expensive to produce.
- Hydrogen is not readily available for fuel at this time.
- Hydrogen is difficult to contain, transport, and store.
- The production of hydrogen requires a lot of energy, and its production produces pollutants.



ASSIGNMENT BOOKLET 4A

Science 9

Module 4: Section 1 Assignment and Section 2 Assignment

Home Instructor's and Student's Comments:

STUDENT FILE NUMBER

(if label is missing or incorrect)

Date Submitted:

Apply Module Label Here

Name

Address

Postal Code

*Please verify that preprinted label is for
correct course and module.*

FOR SCHOOL USE ONLY

Assigned Teacher:

Date Assignment Received:

Grading:

Teacher's Comments

Teacher's Signature

Home Instructor: Keep this sheet when it is returned to you as a record of the student's progress.

INSTRUCTIONS FOR SUBMITTING THIS DISTANCE LEARNING ASSIGNMENT BOOKLET

When you are registered for distance learning courses, you are expected to regularly submit completed assignments for correction. Try to submit each Assignment Booklet as soon as you complete it. Do not submit more than one Assignment Booklet in one subject at the same time. Before submitting your Assignment Booklet, please check the following:

- Are all the assignments completed? If not, explain why.
- Has your work been reread to ensure accuracy in spelling and details?
- Is the booklet cover filled out and the correct module label attached?

MAILING

1. Do **not** enclose letters with your Assignment Booklets. **Send all letters in a separate envelope.**
2. Put your Assignment Booklet in an envelope and take it to the post office and have it weighed. Attach **sufficient postage** and seal the envelope.

FAXING

1. Assignment Booklets may be faxed to the school with which you are registered. Contact your teacher for the appropriate fax number.
2. All faxing costs are the responsibility of the sender.

E-MAILING

It may be possible to e-mail your completed Assignment Booklet to the school with which you are registered. Contact your teacher for the appropriate e-mail address.

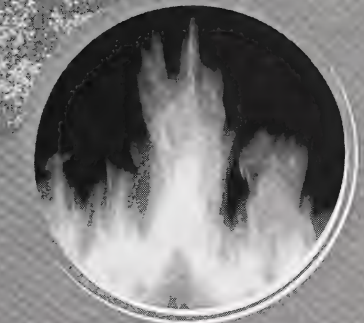
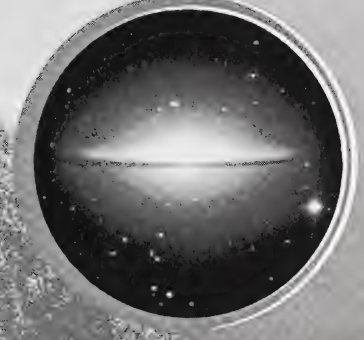
SCIENCE 9

Module

4

Electrical Principles and Technologies

Assignment Booklet 4A



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Summary

	Total Possible Marks	Your Mark
Section 1 Assignment	37	
Section 2 Assignment	36	
	73	

Teacher's Comments

Science 9

Module 4: Electrical Principles and Technologies

Assignment Booklet 4A

Section 1 Assignment and Section 2 Assignment

Learning Technologies Branch

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ASSIGNMENT BOOKLET 4A
SCIENCE 9: MODULE 4
SECTION 1 ASSIGNMENT AND SECTION 2 ASSIGNMENT

Your mark for this module will be determined by how well you do your assignments.

This Assignment Booklet is worth 73 marks out of the total 155 marks for the assignments in Module 4. The value of each assignment and each question is stated in the left margin.

Work slowly and carefully. If you have difficulty, go back and review the appropriate topic.

Be sure to proofread your answers carefully.

37

Section 1 Assignment: The Basics of Electricity

Read all parts of your assignment carefully and record your answers in the appropriate places.

1. Classify the charge of each of the following.

1

- a. A material has 20 billion electrons, 21 billion protons, and 10 billion neutrons.

1

- b. A material has 20 billion electrons, 20 billion protons, and 5 billion neutrons.



2. In the “Find Out Activity: Charge It” on page 266 of the textbook, if the acetate is positive, answer the following questions accordingly.

1

- a. What is the charge on vinyl?

2

- b. Which material has “loose” electrons? Explain.

1

- c. Do the number of protons change in either material? Explain.

2

3. In "Figure 4.1" on page 268 in your textbook, there's a photo of a girl holding onto a Van de Graaf generator. Use the laws of charges to explain why the girl's hairs are standing up in that pattern. Be specific.



Return to page 17 of the Student Module Booklet and continue with Lesson 2.

4

4. All current-carrying circuits have four basic elements. List these basic elements.

4

5. Match each circuit symbol on the right to its meaning on the left. Fill in the answer blanks to the left of the meanings.

_____ a. switch

A.

_____ b. resistor

B.

_____ c. electrochemical cell

C.

_____ d. battery

D.

3

6. Match the following instruments on the right to the related descriptions on the left. Fill in the answer blanks to the left of the descriptions.

_____ a. is connected to two points in the circuit

A. ammeter

_____ b. measures a quantity at a point in the circuit

B. voltmeter

_____ c. is connected so that it is between parts of the circuit

Return to page 25 of the Student Module Booklet and continue with Lesson 3.

③

7. What is the smallest load resistance you can safely use with an extension cord that has a 15 A rating? Remember that Canadian households receive 120 V. Show your work.

②

8. Predict the relative size of the current passing through a clothes iron and an electric shaver. Explain your prediction.

9. A circuit consists of a 9 V battery, a switch, and a small electric motor.

②

- a. What is the voltage across the motor when the switch is closed? Explain.

②

- b. What is the voltage across the motor when the switch is open? Explain.

2

10. To obtain the highest current through a circuit having three light bulbs, would you use a series circuit or a parallel circuit? Explain.

3

11. Determine the voltage across a heating element with a resistance of $32\ \Omega$ when the current passing through it is $6.8\ \text{A}$. Show your work.

2

12. If the resistance of a load increases, will the current increase or decrease? Explain.

2

13. You want to build a simple rheostat to control the brightness of a light. Should you use copper wire, tungsten wire, or nichrome wire? Explain.

36

Section 2 Assignment: Energy Conversions

Read all parts of your assignment carefully and record your answers in the appropriate places.



1. The “Find Out Activity: Show Me the Light!” on page 298 of the textbook deals with these questions:

- How much electricity can be produced by photovoltaic cells?
- What factors affect the output of a photovoltaic cell?

Read the introductory paragraph and “Procedure.” Note the set-up shown in the photograph.

①

- a. What would be the responding variable for this activity?

③

- b. List three specific manipulated variables that could be tested.

④

- c. List two reasons why photovoltaic cells would be a good home power source, and list two reasons why they are not being used extensively. Be sure that you don't just use opposites for your reasons.

Pros

(a) _____

(b) _____

Cons

(a) _____

(b) _____



2. In “Word Connect” from page 294 of the textbook, *heat* is defined as thermal energy that is transferred from a warmer substance to a cooler one.

a. How are heat and work alike?

1

1

b. How do they differ?

3

3. List three different ways in which light can be produced from electricity.

Return to page 39 of the Student Module Booklet and continue with Lesson 2.

2

4. What must a solution have to be considered an electrolyte?

2

5. “Inquiry Investigation 4E: Super Cell Sleuth” on pages 302 and 303 of the textbook deals with making a voltaic cell. You vary the electrodes and electrolytes to see what effects the variations have. Would the voltaic cell used in such an activity work if you used a concentrated salt solution instead of sulfuric acid? Explain.

Return to page 43 of the Student Module Booklet and continue with Lesson 2.



②

6. a. What arrangement of three cells would result in the greatest electric current? Why?

②

- b. What arrangement of three cells would result in the longest life? Why?

⑥

7. List three factors that you could change within a wet cell to create the highest possible voltage. Explain how you would manipulate each factor and why the manipulation would work.

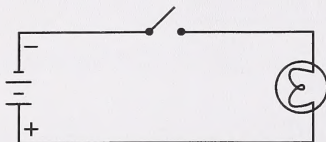
Factor 1

Factor 2

Factor 3

1

8. Use the following diagram to answer this question.



After testing the circuit with a light bulb and finding that it works, a student replaced the bulb with a light-emitting diode. When he closed the switch the LED did not glow. Suggest a possible reason for this.

9. Explain why each of the following wet cells will or will not produce a current. Be specific.

2

- a. a copper and a zinc electrode in an acid solution

2

- b. two zinc electrodes in saltwater

2

- c. an aluminum and a zinc electrode in pure water

2

10. The positive terminals of two C-cells are connected in a series circuit. What potential difference should you measure across the battery? Explain.

Submit your completed Assignment Booklet 4A to your teacher for assessment.
Then return to page 47 of the Student Module Booklet and begin Section 3.

ASSIGNMENT BOOKLET DECLARATIONS

The school you are registered with may require you to submit this signed form with your Assignment Booklet.

The Student's Declaration is to be signed by the student. If the student is under 16, the Supervisor's Declaration may need to be signed by the supervisor, who is usually a home instructor, teacher, or home-schooling coordinator. Failure to complete this page may invalidate the assignment results. Please contact your school and ask if this completed form is required.

STUDENT'S DECLARATION

- I have followed the instructions outlined in the Student Module Booklet.
- I have completed the activities to prepare myself for the assignments in this Assignment Booklet.
- I completed the assignments in this Assignment Booklet by myself.

Student's Signature

SUPERVISOR'S DECLARATION

I hereby certify that I have supervised the learning activities completed by _____.
Student's Name

I also certify that to the best of my knowledge the assignments in this Assignment Booklet were completed independently by this student.

Supervisor's Signature

If you, the student or supervisor, have any comments or observations regarding this module, write them in the following space.
